flower has just opened, only a single very small opening is commonly left free (*o*, Fig. 68); somewhat later, when the longer anthers have advanced a little further, two small openings are frequently obvious (*o o*, Fig. 69), by which Lepidoptera can insert their proboscis. The exclusion, however, of all other insects from the honey would be useless or even fatal to this, as well as to the above mentioned flowers, unless by particular contrivances, (1) increased frequency of the visits of Lepidoptera,

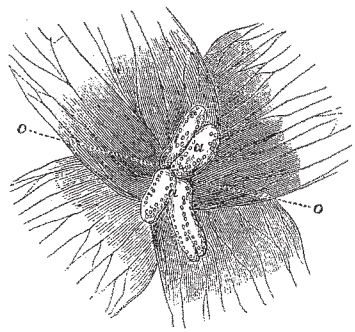

FIG. 69.—The same, at a somewhat later period.

and (2) certain cross-fertilisation by them were effected. *Hesperis tristis*, by the very inconspicuous colour of its flowers, which are yellow reticulated with purplish streaks, by opening them in the afternoon, and by having no smell in the daytime whilst very fragrant towards the evening, proves to be adapted exclusively to crepuscular and nocturnal Lepidoptera, which, attracted from afar by the sweet odour, are induced to pay frequent visits. The base of each of the two shorter filaments is surrounded by a greenish swelling (*n*, Figs. 66, 67), which secretes on its inside honey so copiously that it rises in the interstice between the shorter and the two adjacent longer filaments. Cross-fertilisation by the visits of moths is secured in the following manner. From the one or two small openings (*o*, Figs. 68, 69) the proboscis of the moth is guided downwards by the longer filaments as in a channel, first along one side of the stigma (*st*, Fig. 66), which has bent downwards on both sides just into the way of the proboscis, then

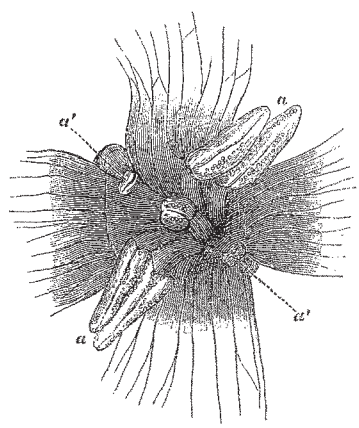

FIG. 70.—The same in its last state.
(Figs. 66–70 are seven times magnified.)

along the shorter anther (*a'*, Fig. 66), which from the other side has turned its pollen-covered front likewise exactly into the way of the proboscis, until at last it reaches the honey (*h*, Fig. 66); the proboscis afterwards wetted with honey at its tip, when retracted, first touches again the anther *a'* with one side, which is thus charged with pollen, then with the other side the stigma, which thus escapes fertilisation with its own pollen, and when in the next visited flower the tip of the proboscis with its pollen-charged side touches the stigma, cross-fertilisation is effected.

My daughter Agnes, perseveringly watching *Hesperis tristis* during several mild evenings in the month of May, has succeeded in observing and catching the following fertilisers of it:—(1) *Plusia gamma*, frequently (length of the proboscis 16-18 mm.); (2) *Hadena sp.* (11 mm.); (3) *Dianthœcia conspersa*, W.V., twice (13 mm.); (4) *Iodis lactearia*, L.; (5) *Botys forficalis*, L., three times.

But although in calm and warm evenings, as is proved by these observations, cross-fertilisation may be sufficiently effected; yet in unfavourable weather all flowers of many individuals develop and fade without experiencing any visit of fertilisers. In this case, nevertheless, almost every ovary develops and brings to maturity its seed-vessels, self-fertilisation being regularly effected by the pistil growing and the stigma coming into contact with pollen-grains of the four longer anthers.

Thus, in these flowers the four longer anthers have apparently no other function in the first period of flowering but to exclude incompetent visitors from the honey, by stopping the entrance of the flower, and, by the direction of their filaments, to keep the proboscis of the fertilisers in the right direction, whilst in a later period, in case visits of moths have been wanting, they regularly effect self-fertilisation. The two shorter anthers, on the contrary, are exclusively adapted to cross-fertilisation by visiting moths.

Lippstadt HERMANN MÜLLER

JOSEPH WINLOCK

THE following details concerning the late Prof. Winlock, whose death we announced last week, we take from the New York *Nation*:—

Prof. Joseph Winlock, Director of the Observatory of Harvard College, died suddenly after a brief illness last Friday morning, June 11, at the age of forty-nine. One of the foremost of American astronomers, whose honourable career in science began thirty years ago, who has filled with great credit several important positions of scientific labour and trust, is thus cut off in the midst of a life whose usefulness cannot be estimated by ordinary standards. Well known and highly estimated by all active collaborators in astronomy both at home and abroad, he was never so well known to others or to the public as his important services deserved. This was chiefly on account of a modest shrinking from any candidacy for honours, amounting almost to an aversion from them, and an indifference to an uncritical or merely popular reputation. Immediately upon graduating from Shelby College, Kentucky, in 1845, he was appointed Professor of Mathematics and Astronomy in that College, where he remained until 1852, when he removed to Cambridge, Mass., and took part in the computations of the *American Ephemeris and Nautical Almanac*, then under the superintendence of Admiral C. H. Davis. In 1857 he was appointed Professor of Mathematics of the United States Navy, and in that capacity served in succession as Assistant at the Naval Observatory at Washington, as Superintendent of the *Nautical Almanac*, and as Director of the Mathematical Department of the Naval Academy at Annapolis, Md. On the breaking out of the war, in 1861, he was a second time made Superintendent of the *Nautical Almanac*. His next service to astronomy was in the position of Director of the Observatory at Harvard College, and Phillips Professor of Astronomy, to which he was appointed in 1865—a position already made highly honourable by the labours of his predecessors, the distinguished astronomers, Professors W. C. Bond and G. P. Bond. He has also served at the same time as Professor of Geodesy in the Mining School of Harvard College. Only a few months ago, Mr. Bristow appointed him the chairman of the Congressional Commission for

Investigating the Causes of Steam-Boiler Explosions. These many appointments to places of responsibility are evidences of the rare sagacity, skill, sound judgment, and integrity of character which were qualities conspicuous to all who knew him well or dealt with him in his various duties. Upon taking charge of the Cambridge Observatory, he proceeded with energy to complete its equipment, adding to its already famous resources a meridian circle, constructed in accordance with his designs by Throughton and Simms of London—an instrument whose performance has been pronounced by competent judges the best of its kind in the world. The distinguished astronomer, Adams, of Cambridge, England, subsequently ordered an instrument from the same makers to be constructed on the same model. Prof. Winlock also secured for this Observatory a very perfect astronomical clock, made by Frodsham of London, from which, through contrivances of his own, true time is telegraphed to neighbouring cities. He also set the famous equatorial instrument of the Observatory upon a new career of usefulness and glory in astronomical spectroscopy. In 1870 he put into regular working efficiency a mode of observing the sun—namely, by a single lens, a heliostat, and photograph—which he independently conceived, and was the first to utilise as a form of systematic observatory work. French astronomers have lately been contending with one another about priority in the conception of this method of observation, which was so important a part of the equipment for observing the transit of Venus last December furnished to American expeditions; but in all that really constitutes effective originality, the honour of this invention undoubtedly belongs to Prof. Winlock. He was, however, almost entirely indifferent, in the singleness of his devotion to his favourite science, to popular fame, or even to contemporary recognition. Besides his observatory work, he was engaged on two occasions in the direction of expeditions to observe solar eclipses—namely, that to Kentucky in August 1869, and that to Spain in December 1870. Though ingenious as an inventor, his judiciousness was so much more prominent a quality that his originality is shown rather in a thoroughness and detailed efficiency of contrivance than in the more brilliant qualities that distinguish the more famous inventors. Very numerous little but very effective improvements in astronomical methods distinguish the astronomical art of the present day; and in these Prof. Winlock's originality was considerable. Among his published works, besides the "Annals of the Observatory" under his directorship, are a set of tables of the planet Mercury (arranged with characteristic neatness and ingenuity); brief papers in astronomical journals and in the *Proceedings of the American Academy of Arts and Sciences*. He was a native of Kentucky, and the grandson of General Joseph Winlock, who entered the American army at the beginning of the Revolutionary War, and also served in the war of 1812, and was a member of the convention which drew up the constitution of the State of Kentucky.

INDIA MUSEUM, SOUTH KENSINGTON

THE India Museum, which was opened in South Kensington last month, was founded by the Court of Directors of the Honourable East India Company in 1798. In 1860 it was removed from Leadenhall Street to Fyfe House, and in 1869 to the India Office. The galleries of the Exhibition Building, in which it is now temporarily lodged, have been leased from H.M. Commissioners for the Exhibition of 1851 for three years. The lower gallery is devoted to Raw Products, and the upper gallery to Manufactures. The present arrangement of the India Museum Collections is to a large extent only temporary, and fulfils mainly the purpose of bringing them into view preparatory to their final classification. The preparation of Descriptive Catalogues will go hand in hand with the completion of the different groups.

A handy little penny Guide has in the meantime been officially issued, which will be found of considerable service in enabling the visitor to make a systematic inspection of the large collections which have been for so long stowed away in various cellars and ware-rooms in the topmost story of the New India Office. Now that this Museum has been brought "to the light of common day," and that the public has a chance of estimating the value of its treasures, we are sure that when the lease of the Exhibition rooms expires, permanent accommodation will be allotted to it, we hope in connection with an India Institute so ably advocated by the Director of the Museum, Dr. Forbes Watson. On four days of the week the charge for admission is only one penny, and sixpence on the other two days. We purpose at present to give some account of the Botanical and Zoological Collections in the Museum.

Room No. 1 is devoted to the commercial products of the vegetable kingdom, with the mechanical appliances associated with their cultivation, collection, or preparation, and is under the superintendence of Dr. M. C. Cooke. A complete collection of these products is exhibited in small tin cases with glass fronts, which are arranged in metal frames, and suffice to give a general view of the productions of the country. Supplemental to this the principal trade articles receive special illustration in a more extended manner in central cases. As this is a new feature in the arrangement of this section, it will take some time before it can be fully and properly developed. What has been done with cotton will in part illustrate what is intended with other products. In this instance the cotton is shown from all parts of India, at first in the boll, then in the seed; afterwards cleaned, together with the seed and oil therefrom, with the waste obtained in the processes of cleaning and spinning and its economic applications. The processes of spinning are next illustrated, with the resultant twists and yarns. These are succeeded by grey and bleached cloth, printing blocks, samples of dyed and printed fabrics, and coloured yarns. Underneath these cases are arranged the agricultural implements employed in the cultivation of cotton, churkas and rollers for cleaning it from the seed, models of spinning wheels and other appliances illustrating the manipulation of the cotton fibre. Above the cases are displayed drawings of the varieties of cotton plants, and of the natives at work at the different processes through which the cotton passes from the ploughing of the soil to the complete woven fabric. By this mode the whole history of the progress of cotton from first to last is exhibited at one view, or at least as much of it as could be compressed within available space. Hitherto, although agriculture, and especially its food products, has been fully illustrated, forestry has not had by any means the share which its importance demands. It is contemplated therefore to expand this new division considerably by the addition of collections of the timbers of the three presidencies and of native states, each by itself, so as to show the character of the forests in each division, accompanied by maps and drawings or photographs of the trees. The products of the forests, other than timber, will be shown collectively for the whole of India, accompanied by such diagrams, drawings, and statistical tables as may be necessary; and the fungoid pests and enemies of arboriculture will also be illustrated. Already this illustrative mode of exhibition has commenced, but will evidently proceed slowly, as diagrams, drawings, and tables will have to be constructed, and probably some of the illustrations must be obtained direct from India.

It may be remarked that Cinchona Bark from the Neilgherry plantations, as well as from Kangra, has the honour of a case to itself, and it is hoped that soon another important drug recently introduced—Ipecacuanha